(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 208 528 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
30.03.2005 Bulletin 2005/13

(21) Application number: **00957208.2**

(22) Date of filing: **24.08.2000**

(51) Int Cl.[7]: **G06K 9/50**, G06K 9/80, A61B 5/117

(86) International application number:
PCT/SE2000/001623

(87) International publication number:
WO 2001/015066 (01.03.2001 Gazette 2001/09)

(54) **METHOD AND ARRANGEMENT FOR REGISTERING AND VERIFYING FINGERPRINT INFORMATION**

VERFAHREN UND VORRICHTUNG ZUR AUFNAHME UND VERIFIKATION VON FINGERABDRUCK-INFORMATIONEN

PROCEDE ET SYSTEME D'ENREGISTREMENT ET DE VERIFICATION D'INFORMATIONS D'EMPREINTES

(84) Designated Contracting States:
DE FR

(30) Priority: **24.08.1999 SE 9902990**

(43) Date of publication of application:
29.05.2002 Bulletin 2002/22

(73) Proprietor: **Fingerprint Cards AB**
403 16 Göteborg (SE)

(72) Inventor: **KRUSE, Björn**
S-602 18 Norrköping (SE)

(74) Representative: **Bergquist, Kjell Gunnar et al**
Albihns Göteborg AB,
Box 142
401 22 Göteborg (SE)

(56) References cited:
GB-A- 2 310 522
US-A- 5 140 642
US-A- 5 239 590

- **LINUS WIEBE ET AL.: 'Automated recognition of fingerprints' PRECISE BIOMETRICS 03 April 1998, page 33, XP002956922**

EP 1 208 528 B1

Description

TECHNICAL FIELD

[0001] The present application relates to a method and an arrangement for registering and verifying fingerprint information.

BACKGROUND ART

[0002] There are a great many fields within which it is necessary to verify the identity of a person, in other words to answer the question of whether a certain person is who he claims to be and is thus authorized to use a certain type of equipment. Examples of such equipment are automatic cash dispensers, access systems and various types of electronic equipment, for example mobile telephones and computers.

[0003] A conventional manner of carrying out verification is for the user to have a code or a password which he has to input in a verification procedure. If the code is correct, the user is considered to be authorized to use the equipment. However, it can be difficult for a user to remember a large number of different codes and passwords, for which reason alternative ways of verifying the authority and/or identity of a user are necessary. One such alternative method is to have a user register information relating to one or more of his fingerprints in a verification unit, the user then, in a verification procedure, placing the finger or fingers whose print is registered against a surface on the verification unit. The unit analyses whether the fingerprint corresponds to the necessary degree to the fingerprint whose information is stored and, if so, the fingerprint is considered verified, and the user is permitted to use the equipment in question.

[0004] Identification by means of fingerprints (see eg. "Automated recognition of Fingerprints" of Linus Wiebe, Precise Biometrics) has traditionally been used mostly within the field of crime prevention, where the question to be answered is not whether a fingerprint corresponds to another to the necessary degree. In that field, an attempt is instead made to establish a match with a specific fingerprint in an extensive register of fingerprints. This type of use of fingerprints does not involve the same great requirement for speed as a verification procedure of the type described above. Speed is also highly desirable in the registering of fingerprint information for use in verification.

[0005] Another important parameter, for both registering and verification of fingerprint information, is reliability.

DISCLOSURE OF INVENTION

[0006] The problem solved by the present invention is therefore that of providing an arrangement and a method affording rapid and reliable registering of fingerprint information, and of providing a corresponding arrangement and method for rapid and reliable verification of a fingerprint on the basis of previously registered fingerprint information.

[0007] This problem is solved by means of a method for registering fingerprint information via a sensing surface A, in which a finger can be held against or over at least a part of the sensing surface A, which method comprises scanning part surfaces in the sensing surface A. During scanning of the part surfaces, it is checked whether the centre point, with its immediate surrounding area, of each scanned part surface is unique within the part surface.

[0008] A number of centre points which, with their respective immediate surrounding areas, are unique in their respective part surfaces are registered, the respective immediate surrounding areas of the points and the respective part surfaces of the points also being registered.

[0009] A certain number of the registered centre points with their immediate surrounding areas are suitably selected for further use, for example for verifying fingerprints.

[0010] The abovementioned problem is also solved by means of a method for verifying fingerprint information via a sensing surface A, against or over at least a part of which sensing surface A a finger can be held, in which verification is carried out on the basis of previously registered information relating to at least one fingerprint which is to be approved in the verification method, and in which information has preferably been registered according to the registering method described above.

[0011] The verification method according to the invention comprises a number of part surfaces with their respective centre points in the fingerprint whose information is stored being compared with corresponding part surfaces on the sensing surface A. If there is a point on a part surface on the sensing surface A which, with its immediate surrounding area, corresponds, on the basis of certain criteria, to the stored centre point, including the immediate surrounding area of the stored centre point in the corresponding stored part surface, the point with its part surface is approved. If a certain number of points with associated part surfaces have been approved, these are selected for a first step in further processing.

[0012] This first step in further processing suitably comprises a number of the selected points and the part surfaces being analysed as a group, the mean value of the coordinates for the points in their respective part surfaces being calculated. The mean value calculated is seen as a point in each part surface, and a certain number of the points with their associated part surfaces are selected for a second step in further processing, the points which are selected being those points in the group which have the smallest distance to the mean value point in their respective part surface. This is done in order that an arrangement or a method according to the

invention will be independent of translation of the print at the time of verification in relation to the position of the finger at the time of registering, translation being defined as right-angled displacements of the finger relative to the position of the finger at the time of registering.

[0013] The invention also comprises a method for making it possible to be independent of rotation of the finger at the time of verification in relation to the position of the finger at the time of registering. This method will be described in greater detail below.

[0014] The invention also comprises arrangements for use in the methods of the types mentioned above.

BRIEF DESCRIPTION OF DRAWINGS

[0015] The invention will be described in greater detail below with reference to the appended drawings, in which

Fig. 1 shows a rough block diagram of an arrangement according to the invention,
Fig. 2 shows a basic diagram of the use according to the invention of a part surface on a sensor,
Fig. 3 shows the principle of a calculation according to the invention, and
Fig. 4 shows how a verification method according to the invention can be made insensitive to rotation.

MODE(S) FOR CARRYING OUT THE INVENTION

[0016] Fig. 1 shows a rough block diagram of an arrangement 100 according to the invention. The arrangement 100 comprises a central unit 110, a sensor 120, a power supply unit 130, and connections, shown by arrows, between the units. The central unit 110 suitably comprises control arrangements, a memory and at least one arithmetic logic unit (ALU). The control arrangements and the ALU together preferably consist of an integrated circuit, for example a microprocessor.

[0017] The power supply unit 130 is not of major interest in terms of the invention and will therefore not be described in greater detail. In brief, it can be stated that the power supply can be effected in a great many ways known to the expert, for example batteries, mains connection or solar cells, and can be integrated in the same housing as the rest of the arrangement 100 or separate.

[0018] The sensor 120 has a sensing surface A, against or over at least a part of which sensing surface A a finger can be held during use of the arrangement. The sensor 120 comprises a number of sensor elements for scanning the sensing surface A. The sensor elements are preferably capacitive, but other types of sensor element can also be used according to the invention, for example resistive, optical or heat-sensitive elements. Another type of sensor which could be used in connection with the present invention is a pressure-sensitive sensor.

[0019] The number of sensor elements per unit area on the sensing surface A can be selected in a great many ways, depending on, for example, the type of sensor, and the desired speed, reliability and resolution. In a preferred embodiment of the invention, with capacitive sensor elements, roughly 200 sensor elements are used per mm^2, which corresponds to 144x144 points per cm^2, which on a length scale can be expressed as 14 elements per millimetre. This number is to be considered as only an example, however, and the number of sensor elements per unit area can be either larger or smaller in other embodiments of the invention. However, the number of sensor elements preferably lies within the range 10-50 elements per millimetre.

[0020] As mentioned above, the arrangement 100 is intended to be used for registering fingerprint information and for verifying fingerprint information on the basis of previously registered information relating to at least one fingerprint which is to be approved on verification. The previously registered information used for verifying fingerprints has preferably been registered by means of a method according to the invention.

[0021] Below, a method of registering fingerprint information according to the invention will be described first, and then a method for verifying fingerprint information according to the invention will be described. These methods are implemented by means of an arrangement according to the invention. Both the description of registering and the description of verification below will be given with reference to Fig. 2. None of the parts in Fig. 2 is provided with an index, but parts which have been provided with an index in the text refer to corresponding unindexed parts in Fig. 2.

[0022] In a method for registering fingerprint information according to the invention, the user places the finger whose information is to be registered against or over a part of the sensing surface A (shown in Fig. 2) on the sensor 120. The central unit 110 then initiates scanning of the sensing surface A of the sensor 120, which is carried out by part surfaces A'_1 on the sensing surface A being scanned. The part surfaces A'_1 preferably overlap one another in a predetermined manner. The part surfaces A'_1 are suitably all of the same size, which can of course be varied in a great many different ways. However, a suitable range for the size of the part surfaces A', is 5-50% of the total sensor surface A, 10% of the total sensor surface having been found to be advantageous.

[0023] During scanning of the part surfaces A'_1, it is investigated, preferably in the central unit 110, whether the centre point P_1 of the part surface, with its immediate surrounding area A''_1, is unique within the part surface A'_1. If so, the point P_1 is approved and is registered together with its immediate surrounding area in the memory of the arrangement 100. The part surface A'_1 to which the centre point belongs is also registered.

[0024] Scanning of the sensor surface A preferably continues until the central unit 110 has found a certain predetermined first number of centre points P_1 which,

including their immediate surrounding areas A''_1, are unique within their part surfaces A'_1. When the predetermined first number of centre points P_1 has been found and registered, registering of the finger is considered complete.

[0025] An alternative way of carrying out the scanning is to scan the part surfaces A'_1 in a given pattern, data on the centre points P_1 of all the part surfaces A'_1 being gathered and stored. When all the part surfaces A'_1 have been scanned, the central unit 110 selects a predetermined number of centre points P_1 which best meet certain criteria with regard to the requirement that the centre point P_1 is to be unique in its part surface A'_1.

[0026] A further alternative way of carrying out the scanning, which can save memory space, is to store the predetermined number of centre points P_1 in a table which is updated throughout the scanning process with the centre points which best meet the abovementioned criteria.

[0027] All the first number of stored centre points P_1 can of course be used for verifying a finger, but, in a particularly preferred embodiment of the invention, the central unit 110 selects a second number of the registered centre points P_1 with their respective immediate surrounding areas A''_1 for further use, the centre points P_1 which are selected being those which best meet certain predetermined criteria. The exact sizes of the first and the second number of centre points are of course dimensioning parameters which are determined by the desired speed and reliability of the registering method, but it has been found to be advantageous if the first number lies within the range 10-100 points, and the second number lies within the range 20-80% of the first number. In a particularly preferred embodiment, 24 and, respectively, 16 points are used.

[0028] A method for verifying fingerprint information according to the invention will be described below. The type of verification for which the invention is primarily intended is to check whether the fingerprint of a finger which is held against or over the sensing surface A of the sensor corresponds to a fingerprint whose information was registered previously.

[0029] For verifying a fingerprint according to the invention, the user therefore places a finger against or over a part of the sensing surface A on the sensor 120. The central unit 110 initiates scanning of the sensing surface A of the sensor 120, which is carried out by a number of part surfaces A'_2 on the sensing surface A being scanned. In terms of size and position on the sensing surface A, the scanned part surfaces A'_2 preferably correspond to the part surfaces used in the registering method described above, which means that each part surface A'_1 in the fingerprint data which is registered corresponds to a part surface A'_2 for verification. The part surfaces A'_2 which are analysed first in the verification method are those which correspond to the part surfaces A'_1 whose respective centre points P_1 are registered.

[0030] If, when a part surface A'_2 is scanned, it emerges that a point P_2 in the part surface A'_2, with its immediate surrounding area A''_2, has, on the basis of certain criteria, sufficient similarity to the centre point P_1 and its immediate surrounding area A''_1 in the corresponding registered part surface A'_1, the point P_2 is approved provisionally, and its coordinates in relation to the part surface A'_2 are stored in the memory of the arrangement 100. The coordinate system used is suitably an orthogonal x-y system in each part surface A'_2 with the origin in the centre of the part surface. If more than one point P_2 in a part surface A'_2 meets said criteria, the point P_2 which best meets the criteria is selected.

[0031] If a certain number of points P_2 have been approved and stored for the finger which is held against the sensing surface A, these points are selected for a first step in further processing.

[0032] In a possible verification method, the first step in the further processing quite simply comprises the fingerprint being considered verified, in other words the fingerprint which is held against or over the sensing surface A is considered to be identical with the fingerprint whose information is registered, if the number of approved points P_2 exceeds a certain predetermined number. If greater reliability in verification is desired, however, the first step in the further processing can suitably also comprise the following, which is described with reference to Fig. 3.

[0033] The stored points P_2 are analysed as a group, and the mean value of the coordinates (x_m,y_m) for all the points P_2 is calculated, analysis and calculation suitably being carried out in the central unit 110. The calculation therefore provides a coordinate pair (x_m,y_m) which can be seen as a point in each part surface A'_2. The points P_2 in the group are then arranged in a list, starting from the absolute value of the distance d between the coordinates (x_2,y_2) of a point and the calculated mean value point (x_m,y_m). The distance d in a part surface A'_2 is illustrated diagrammatically in Fig. 3.

[0034] A certain number of the points highest on the list are then selected for a second step in further processing. If appropriate, this second step can quite simply comprise the fingerprint being considered verified, in other words the fingerprint which is held against or over the sensing surface A is considered to be identical with the fingerprint whose information is stored, if a sufficient number of points have an absolute value d below a certain value. If greater reliability in verification is desired, however, the second step in the further processing can suitably comprise the following:

[0035] The mean value of the coordinates (x_2,y_2) of the selected points is calculated, and the absolute value of the distance between this mean value point and the coordinates (x_2,y_2) of each selected point is analysed. If a certain number of points P_2 have a distance to the mean value point with an absolute value which is below a certain limit value, the fingerprint is considered verified, in other words the fingerprint which is held against

or over the sensing surface A is considered to be identical with the fingerprint whose information is registered.

[0036] The numbers of points required in the various steps of the verification method are of course, in the same way as with the numbers in the registering method, dimensioning parameters which are selected on the basis of the combination of speed and reliability desired in the arrangement. By way of example, however, it may be mentioned that the number of points selected for a first step in further processing during verification can suitably correspond to the number of points selected in the final step of registering, in the present case, in other words, 16 points. The number of points selected for a second step in further processing in verification suitably lies within the range 20-60% of the number of points selected for the first step, preferably 50%, in the present case, therefore, 8 points.

[0037] The verification method described above means that good results are obtained even if, during a verification procedure, a user holds his finger displaced at right angles in the lateral or longitudinal direction in relation to the position the finger was in at the time of registering. As the user may also, at the time of verification, hold his finger in a rotated position in relation to the position the finger was in at the time of registering, the invention comprises means and a method to make it possible to carry out verification with good results even in such cases. This will be described below with reference to Fig. 4.

[0038] In order that the verification will be insensitive to rotation of the finger, scanning and comparison are carried out according to the above description, in other words part surfaces A'_2 on the sensing surface are scanned. These part surfaces A'_2 are compared with corresponding part surfaces A'_1 in the registered fingerprint with regard to centre points and the immediate surrounding areas of the centre points. In order to achieve rotation-insensitivity, however, each part surface A'_2 is displaced into a number of different angular positions α around an imaginary vertical line L on the sensing surface A before it is compared with the corresponding part surface A'_1. Comparison is then carried out with the part surfaces A'_2 in each of these angular positions. If, in one and the same angular position, said number of points P_2 have sufficient similarity, on the basis of the above-mentioned criteria, to their corresponding registered part surfaces A'_1, these centre points P_2 are selected for a first step in further processing, according to the description above.

[0039] In the same way as described above, the scanning over the sensing surface A of the sensor 120 is controlled by the central unit 110 of the arrangement 100 in the rotation-insensitive case also. The different angular positions a are achieved by information about the finger which is held against the sensing surface A being stored in the memory 110 of the arrangement in the angular position in which the user holds the finger, after which rotation of the stored information takes place before comparison is carried out.

[0040] The number of angular positions into which the part surfaces A'_2 are displaced can in principle be arbitrary, but the number of angular positions preferably lies within the range 10-100, and 16 angular positions can advantageously be used. The locations of the angular positions can in principle be selected freely, but, in a preferred embodiment, an odd number of angles α is selected around an imaginary centre line L on the sensing surface A, with one angular position which corresponds to α=0, and an even number of angular positions of the same magnitude on each side of the centre line.

[0041] The invention is not limited to the embodiments described above but can be varied freely within the scope of the patent claims below.

Claims

1. Method for registering fingerprint information via a sensing surface A, against or over at least a part of which sensing surface A a finger can be held, **characterized in that** the method comprises:

   - scanning part surfaces A'_1 in the sensing surface A,
   - checking whether the centre point P_1, with its immediate surrounding area A''_1, of each part surface A'_1 scanned is unique within the part surface A'_1,
   - registering a first number of centre points P1 which, with their respective immediate surrounding areas A"1, are unique in their respective part surfaces A' 1,
   - registering also the respective immediate surrounding areas A"1 of the points P1 and the respective part surfaces A'1.

2. Method according to claim 1, according to which a certain second number of the registered centre points P_1, with their immediate surrounding areas A''_1, are selected for further use.

3. Method for verifying fingerprint information via a sensing surface A, against or over at least a part of which sensing surface A a finger can be held, in which verification is carried out on the basis of previously registered information relating to at least one fingerprint which is to be approved in the verification method, which information comprises centre points, their respective immediate surrounding areas and their respective part surfaces, **characterized in that** the method comprises the following:

   - comparing a number of part surfaces A' 1 with their respective centre points P1 of the fingerprint whose information is registered, with corresponding part surfaces A'2 on the sensing

surface A,

- approving the point P2 with its part surface A'2 if the point P2, with its immediate surrounding area A"2, on part surface A'2 on the sensing surface corresponds, on the basis of certain criteria, to the registered centre point P1, including the immediate surrounding area A"1 of the stored centre point in the corresponding stored part surface A'1,
- if a certain number of points P2, each belonging to a different part surfaces A'2, have been approved, alternatively either considering the fingerprint as verified, or, if greater reliability in verification is desired, selecting the points P2 for a first step in a further processing.

4. Method according to claim 3, also comprising information about the part surfaces A'_2, for comparison with the part surfaces A'_1, being displaced into a predetermined number of angular positions, comparison being carried out with the part surfaces A'_2 in each of said angular positions, and, if said number of points P_2 of part surfaces A'_2 satisfy said conditions in one and the same angular position, these points P_2 being selected for the first step in the further processing.

5. Method for verifying fingerprints according to claim 3 or 4, according to which the first step in the further processing of the selected points P_2 with their respective part surfaces A_2 comprises a number of the selected points P_2 and the part surfaces A_2 being analysed as a group as follows:

- the mean value of the coordinates (x,y) for the points P_2 in their respective part surfaces A_2 is calculated,
- the mean value calculated is seen as a point in each part surface A_2,
- a certain number of the points P_2 with their associated part surfaces A_2 are selected for a second step in a further processing, the points P_2 which are selected being those points in the group which have the smallest distance to the mean value point in their respective part surface A_2.

6. Method for verifying fingerprints according to claim 5, according to which the second step in the further processing of selected points P_2 with respective part surfaces A_2 comprises a number of the selected points P_2 and the part surfaces A_2 being analysed as a group as follows:

- the mean value of the coordinates (x,y) for the points P_2 in the part surfaces A_2 is calculated,
- the mean value calculated is seen as a point in each part surface A_2,
- the distance between the points P_2 in the group and the mean value point is analysed,
- if the distance between a certain number of points P_2 and the mean value point is below a certain limit value, the fingerprint is considered verified.

7. Arrangement (100) for use for registering fingerprint information, comprising a central unit (110), a sensor (120) with a sensing surface A, against or over at least a part of which sensing surface A a finger can be held, and a power supply unit (130), **characterized in that** it comprises:

- means (110, 130) for scanning part surfaces A'_1 in the sensing surface A of the sensor (120),
- means (110, 130) for analysing whether the centre point P_1, with its immediate surrounding area $A"_1$, of a scanned part surface A'_1 is unique within the part surface A'_1,
- means (110, 130) for registering a first number of centre points P_1 which, with their respective immediate surrounding areas $A"_1$, are unique in their respective part surfaces A'_1,
- means (110, 130) for registering the part surfaces A'_1 whose centre points P_1 are registered.

8. Arrangement (100) according to claim 6, also comprising means (110) for selecting a certain second number of the registered part surfaces A'_1 with associated centre points P_1 and immediate surrounding areas $A"_1$ for further use.

9. Arrangement (100) for use for verifying fingerprints on the basis of previously registered information relating to at least one fingerprint which is to be approved by means of the arrangement, which information comprises centre points, their respective immediate surrounding areas and their respective part surfaces, the arrangement (100) comprises a central unit (110), a sensor (120) with a sensing surface A, against or over at least a part of which sensing surface A a finger can be held, and a power supply unit (130), **characterized in that** it comprises the following:

- means (110, 130) for comparing a number of part surfaces A'_1 with respective centre points P_1 in the fingerprint whose information is registered with corresponding part surfaces A'_2 on the sensing surface A,
- means (110) for selecting and approving a number of points P2, no more than one per part surface A'2, with corresponding part surfaces A'_2 on the sensing surface A, which points P_2, with their immediate surrounding areas $A"_2$, correspond, on the basis of certain criteria, to

the stored centre point P_1, including the immediate surrounding area $A"_1$ of the stored centre point in the corresponding stored part surface A'_1,

- means (110) for processing the approved points in a first step in further processing.

10. Arrangement according to claim 9, also comprising means (110, 130) for displacing information about the part surfaces A'_2, for comparison with the part surfaces A'_1, into a predetermined number of angular positions, the means for comparison (110, 130) carrying out comparison in each of said angular positions, and the means (110) for selecting and approving a number of points, for the first step in the further processing, approving said number of points P_2 of part surfaces A'_2, if these points satisfy said conditions in one and the same angular position.

11. Arrangement (100) according to claim 9 or 10, also comprising the following means for carrying out said first step in the further processing:

- means (110) for analysing a group of the approved points P_2 and the part surfaces A_2,
- means (110) for calculating a mean value point for the coordinates (x,y) of the points P_2 in the part surfaces A_2 in the group,
- means (110) for selecting a certain number of the points P_2 with their associated part surfaces A_2 for a second step in further processing, the points P_2 which are selected being those points which have the smallest distance to the mean value point in their respective part surface A_2.

12. Arrangement (100) according to claim 11, also comprising the following means for carrying out said second step in the further processing:

- means (110) for analysing a group of the points P_2 and the part surfaces A_2 selected for a second step,
- means (110) for calculating a mean value point for the coordinates (x,y) of the points P_2 in the part surfaces A_2 in the group,
- means (110) for calculating the distances between the points P_2 in the group and the mean value point,
- means (110) for analysing whether the distance between a certain number of points P_2 and the mean value point is below a certain limit value, in which case the fingerprint is considered verified.

Patentansprüche

1. Verfahren zum Aufzeichnen von Fingerabdruckinformationen mittels einer Erfassungsoberfläche A, wobei wenigstens gegenüber oder über einem Teil dieser Erfassungsoberfläche A ein Finger gehalten werden kann, **dadurch gekennzeichnet, dass** das Verfahren umfasst:

- Abtasten von Teiloberflächen A'_1 in der Erfassungsoberfläche A,
- Prüfen, ob der Mittelpunkt P_1 und sein unmittelbarer Umgebungsbereich $A"_1$ jeder abgetasteten Teiloberfläche A'_1 in der Teiloberfläche A'_1 eindeutig ist,
- Aufzeichnen einer ersten Anzahl von Mittelpunkten P_1, die zusammen mit ihren jeweiligen unmittelbaren Umgebungsbereichen $A"_1$ in ihren jeweiligen Teiloberflächen A'_1 eindeutig sind,
- Aufzeichnen auch der jeweiligen unmittelbaren Umgebungsbereiche $A"_1$ der Punkte P_1 und der jeweiligen Teiloberflächen A'_1.

2. Verfahren nach Anspruch 1, bei dem eine bestimmte zweite Anzahl aufgezeichneter Mittelpunkte P_1 zusammen mit ihren unmittelbaren Umgebungsbereichen $A"_1$ für die weitere Verwendung ausgewählt werden.

3. Verfahren zum Verifizieren von Fingerabdruckinformationen mittels einer Erfassungsoberfläche A, wobei wenigstens gegenüber oder über einem Teil dieser Erfassungsoberfläche A ein Finger gehalten werden kann, wobei die Verifikation anhand von im Voraus aufgezeichneten Informationen in Bezug auf wenigstens einen Fingerabdruck, der in dem Verifikationsverfahren bestätigt werden soll, ausgeführt wird, wobei die Informationen Mittelpunkte, ihre jeweiligen unmittelbaren Umgebungsbereiche und ihre jeweiligen Teiloberflächen umfassen, **dadurch gekennzeichnet, dass** das Verfahren die folgenden Schritte umfasst:

- Vergleichen einer Anzahl von Teiloberflächen A'_1 mit ihren entsprechenden Mittelpunkten P_1 des Fingerabdrucks, dessen Informationen aufgezeichnet sind, mit entsprechenden Teiloberflächen A'_2 auf der Erfassungsoberfläche A,
- Akzeptieren des Punkts P_2 mit seiner Teiloberfläche A'_2, falls der Punkt P_2 zusammen mit seinem unmittelbaren Umgebungsbereich $A"_2$ auf der Teiloberfläche A'_2 auf der Erfassungsoberfläche, auf der Grundlage bestimmter Kriterien, dem aufgezeichneten Mittelpunkt P_1 einschließlich des unmittelbaren Umgebungsbereichs $A"_1$ des gespeicherten Mittelpunkts in der entsprechenden gespeicherten Teiloberfläche A'_1 entspricht,
- falls eine bestimmte Anzahl von Punkten P_2,

wovon jeder zu einer anderen Teiloberfläche A'_2 gehört, akzeptiert worden sind, alternativ entweder Betrachten des Fingerabdrucks als verifiziert, oder, falls eine höhere Verifikationszuverlässigkeit gewünscht ist, Auswählen der Punkte P_2 für einen ersten Schritt in einer weiteren Verarbeitung.

4. Verfahren nach Anspruch 3, das außerdem Informationen über die Teiloberflächen A'_2 umfasst, die für den Vergleich mit den Teiloberflächen A'_1 in eine vorgegebene Anzahl von Winkelpositionen verlagert sind, wobei der Vergleich mit den Teiloberflächen A'_2 in jeder der Winkelpositionen ausgeführt wird und wobei, falls die Anzahl von Punkten P_2 von Teiloberflächen A'_2 die Bedingungen in ein und derselben Winkelposition erfüllen, diese Punkte P_2 für den ersten Schritt in der weiteren Verarbeitung ausgewählt werden.

5. Verfahren zum Verifizieren von Fingerabdrücken nach Anspruch 3 oder 4, bei dem der erste Schritt in der weiteren Verarbeitung der ausgewählten Punkte P_2 zusammen mit ihren jeweiligen Teiloberflächen A_2 die Analyse einer Anzahl der ausgewählten Punkte P_2 und der Teiloberflächen A_2 als Gruppe in der folgenden Weise umfasst:

- der Mittelwert der Koordinaten (x, y) für die Punkte P_2 in ihren jeweiligen Teiloberflächen A_2 wird berechnet,
- der berechnete Mittelwert wird als ein Punkt in jeder Teiloberfläche A_2 angesehen,
- eine bestimmte Anzahl der Punkte P_2 mit ihren zugeordneten Teiloberflächen A_2 werden für einen zweiten Schritt in einer weiteren Verarbeitung ausgewählt, wobei die Punkte P_2, die ausgewählt werden, jene Punkte in der Gruppe sind, die den kleinsten Abstand zu dem Mittelwertpunkt in ihrer jeweiligen Teiloberfläche A_2 besitzen.

6. Verfahren zum Verifizieren von Fingerabdrücken nach Anspruch 5, bei dem der zweite Schritt in der weiteren Verarbeitung ausgewählter Punkte P_2 zusammen mit den jeweiligen Teiloberflächen A_2 die Analyse einer Anzahl der ausgewählten Punkte P_2 und der Teiloberflächen A_2 als eine Gruppe in der folgenden Weise umfasst:

- der Mittelwert der Koordinaten (x, y) für die Punkte P_2 in den Teiloberflächen A_2 wird berechnet,
- der berechnete Mittelwert wird als ein Punkt in jeder Teiloberfläche A_2 angesehen,
- der Abstand zwischen den Punkten P_2 in der Gruppe und dem Mittelwertpunkt wird analysiert,
- falls der Abstand zwischen einer bestimmten Anzahl von Punkten P_2 und dem Mittelwertpunkt unter einem bestimmten Grenzwert liegt, wird der Fingerabdruck als verifiziert angesehen.

7. Anordnung (100) für die Verwendung zur Aufzeichnung von Fingerabdruckinformationen, die eine Zentraleinheit (110), einen Sensor (120) mit einer Erfassungsoberfläche A, wobei wenigstens gegenüber oder über einem Teil dieser Erfassungsoberfläche A ein Finger gehalten werden kann, und eine Leistungsversorgungseinheit (130) umfasst, **dadurch gekennzeichnet, dass** sie umfasst:

- Mittel (110, 130) zum Abtasten von Teiloberflächen A'_1 in der Erfassungsoberfläche A des Sensors (120),
- Mittel (110, 130) zum Analysieren, ob der Mittelpunkt P_1 zusammen mit seinem unmittelbar umgebenden Bereich A''_1 einer abgetasteten Teiloberfläche A'_1 in dieser Teiloberfläche A'_1 eindeutig ist,
- Mittel (110, 130), die eine erste Anzahl von Mittelpunkten P_1 aufzeichnen, die zusammen mit ihren jeweiligen unmittelbaren Umgebungsbereichen A''_1 in ihren jeweiligen Teiloberflächen A'_1 eindeutig sind,
- Mittel (110, 130), die die Teiloberflächen A'_1, deren Mittelpunkte P_1 aufgezeichnet werden, aufzeichnen.

8. Anordnung (100) nach Anspruch 6, die außerdem Mittel (110) umfasst, die eine bestimmte zweite Anzahl der aufgezeichneten Teiloberflächen A'_1 mit zugeordneten Mittelpunkten P_1 und unmittelbaren Umgebungsbereichen A''_1 für die weitere Verwendung auswählen.

9. Anordnung (100) für die Verwendung zur Verifizierung von Fingerabdrücken anhand von im Voraus aufgezeichneten Informationen bezüglich wenigstens eines Fingerabdrucks, der mittels der Anordnung akzeptiert werden soll, wobei die Informationen Mittelpunkte, ihre entsprechenden unmittelbaren Umgebungsbereiche und ihre entsprechenden Teiloberflächen umfassen, wobei die Anordnung (100) eine Zentraleinheit (110), einen Sensor (120) mit einer Erfassungsoberfläche A, wobei wenigstens gegenüber oder über einem Teil dieser Erfassungsoberfläche A ein Finger gehalten werden kann, und eine Leistungsversorgungseinheit (130) umfasst, **dadurch gekennzeichnet, dass** sie Folgendes umfasst:

- Mittel (110, 130), die eine Anzahl von Teiloberflächen A'_1 mit entsprechenden Mittelpunkten P_1 in dem Fingerabdruck, dessen Informatio-

nen aufgezeichnet sind, mit entsprechenden Teiloberflächen A'_2 auf der Erfassungsoberfläche A vergleichen,

- Mittel (110), die eine Anzahl von Punkten P_2, nicht mehr als einen pro Teiloberfläche A'_2, mit entsprechenden Teiloberflächen A'_2 auf der Erfassungsoberfläche A auswählen und akzeptieren, wobei die Punkte P_2 mit ihren unmittelbaren Umgebungsbereichen A''_2, auf der Grundlage bestimmter Kriterien, dem gespeicherten Mittelpunkt P_1 einschließlich des unmittelbaren Umgebungsbereichs A''_1 des gespeicherten Mittelpunkts in der entsprechenden gespeicherten Teiloberfläche A'_1 entsprechen,
- Mittel (110), die die in einem ersten Schritt anerkannten Punkte in einer weiteren Verarbeitung verarbeiten.

10. Anordnung nach Anspruch 9, die außerdem Vergleichsmittel (110, 130) umfasst, die Informationen über die Teiloberflächen A'_2, um sie mit den Teiloberflächen A'_1 zu vergleichen, in eine vorgegebene Anzahl von Winkelpositionen verlagern, wobei die Vergleichsmittel (110, 130) den Vergleich in jeder der Winkelpositionen ausführen, wobei die Mittel (110) zum Auswählen und Akzeptieren einer Anzahl von Punkten für den ersten Schritt in der weiteren Verarbeitung die Anzahl von Punkten P_2 von Teiloberflächen A'_2 anerkennen, falls diese Punkte die Bedingungen in ein und derselben Winkelposition erfüllen.

11. Anordnung (100) nach Anspruch 9 oder 10, die außerdem die folgenden Mittel umfasst, um den ersten Schritt in der weiteren Verarbeitung auszuführen:

- Mittel (110) zum Analysieren einer Gruppe der akzeptierten Punkte P_2 und der Teiloberflächen A_2,
- Mittel (110), die einen Mittelwertpunkt für die Koordinaten (x, y) der Punkte P_2 in den Teiloberflächen A_2 in der Gruppe berechnen,
- Mittel (110), die eine bestimmte Anzahl der Punkte P_2 mit ihren zugeordneten Teiloberflächen A_2 für einen zweiten Schritt in der weiteren Verarbeitung auswählen, wobei die Punkte P_2, die ausgewählt werden, jene Punkte sind, die den kleinsten Abstand zu dem Mittelwertpunkt in ihrer jeweiligen Teiloberfläche A_2 besitzen.

12. Anordnung (100) nach Anspruch 11, die außerdem die folgenden Mittel zum Ausführen des zweiten Schrittes in der zweiten Verarbeitung umfasst:

- Mittel (110) zum Analysieren einer Gruppe der Punkte P_2 und der Teiloberflächen A_2, die für einen zweiten Schritt ausgewählt werden,
- Mittel (110) zum Berechnen eines Mittelwertpunkts für die Koordinaten (x, y) der Punkte P_2 in den Teiloberflächen A_2 in der Gruppe,
- Mittel (110) zum Berechnen der Abstände zwischen den Punkten P_2 in der Gruppe und dem Mittelwertpunkt,
- Mittel (110), die analysieren, ob der Abstand zwischen einer bestimmten Anzahl von Punkten P_2 und dem Mittelwertpunkt unter einem bestimmten Grenzwert liegt, wobei in diesem Fall der Fingerabdruck als verifiziert betrachtet wird.

Revendications

1. Procédé d'enregistrement d'informations d'empreintes digitales au moyen d'une surface de détection A, un doigt pouvant être maintenu contre ou sur au moins une partie de cette surface de détection A, **caractérisé en ce que** le procédé consiste à :

- balayer des surfaces partielles A'_1 dans la surface de détection A,
- vérifier si le point central P_1, avec la zone A''_1 qui l'entoure directement, de chaque surface partielle A'_1 balayée est unique dans la surface partielle A'_1,
- enregistrer un premier nombre de points centraux P_1 qui, avec les surfaces respectives A''_1 qui les entourent directement, sont uniques dans leurs surfaces partielles respectives A'_1,
- enregistrer également les zones respectives A''_1 qui les entourent directement, des points P_1 et des surfaces partielles respectives A'_1.

2. Procédé selon la revendication 1, selon lequel un certain second nombre de points centraux enregistrés P_1, ainsi que les zones A''_1 qui les entourent directement, sont sélectionnés pour une utilisation ultérieure.

3. Procédé pour vérifier des informations d'empreintes digitales par l'intermédiaire d'une surface de détection A, selon lequel un doigt peut être maintenu contre ou au-dessus d'au moins une partie de cette surface de détection A, selon lequel une vérification est exécutée sur la base d'informations enregistrées précédemment, concernant au moins une empreinte digitale qui doit être approuvée dans le procédé de vérification, lesquelles informations comprennent des points centraux, leurs zones respectives, qui les entourent directement, et leurs surfaces partielles respectives,
caractérisé en ce que le procédé comprend les opérations suivantes consistant à :

- comparer un nombre de surfaces partielles A'_1 à leurs points centraux respectifs P_1 de l'empreinte digitale, dont les informations sont enregistrées, à des surfaces partielles correspondantes A'_2 sur la surface de détection A,
- approuver le point P_2 avec sa surface partielle A'_2 si le point P_2, avec la surface $A"_2$ qui l'entoure directement, sur la surface partielle A'_2 sur la surface de détection correspondant, sur la base de certains critères, au point central enregistré P_1, incluant la surface $A"_1$, qui l'entoure directement, du point central mémorisé dans la surface partielle mémorisée correspondante A'_1,
- sinon, si un certain nombre de points P_2, dont chacun fait partie d'une surface opérationnelle différente A'_2, a été approuvé, prendre en compte l'empreinte digitale telle qu'elle est vérifiée ou, si une plus grande fiabilité est désirée dans la vérification, sélectionner les points P2 pour une première étape lors d'un traitement suivant.

4. Procédé selon la revendication 3, comprenant également une information concernant les surfaces partielles A'_2, à des fins de comparaison avec les surfaces partielles A'_1, déplacées dans un nombre prédéterminé de positions angulaires, cette comparaison étant exécutée avec les surfaces partielles A'_2 dans chacune desdites positions angulaires et, si ledit nombre de points P_2 sur les surfaces partielles A'_2 satisfait auxdites conditions dans une même position angulaire, ces points P_2 sont sélectionnés pour la première étape lors du traitement suivant.

5. Procédé pour vérifier des empreintes digitales selon la revendication 3 ou 4, selon lequel la première étape du traitement suivant des points sélectionnés P_2 avec leurs surfaces partielles respectives P_2 comprend un certain nombre des points sélectionnés P_2 et des surfaces partielles A_2 analysées en tant que groupe comme suit :

- la valeur moyenne des coordonnées (x,y) pour les points P_2 dans leurs surfaces partielles respectives A_2 est calculée;
- la valeur moyenne calculée est vue comme en tant que point dans chaque surface partielle A_2,
- un certain nombre des points P_2 avec leurs surfaces partielles associées A_2 sont sélectionnés pour une seconde étape dans un traitement suivant, les points P_2, qui sont sélectionnés, étant les points du groupe, qui possèdent la plus faible distance par rapport au point de valeur médiane dans leur surface partielle respective A_2.

6. Procédé pour vérifier des empreintes digitales selon la revendication 5, selon lequel la seconde étape lors du traitement suivant de points sélectionnés P_2 avec des surfaces partielles respectives A_2 comprend un certain nombre des points sélectionnés P_2 et les surfaces partielles A_2 étant analysées en tant que groupe comme suit :

- la valeur moyenne des coordonnées (x,y) pour les points P_2 dans leurs surfaces partielles respectives A_2 est calculée;
- la valeur moyenne calculée est vue en tant que point dans chaque surface partielle A_2,
- la distance entre les points P_2 dans le groupe et le point de valeur moyenne est analysée,
- si la distance entre un certain nombre de points P_2 et le point de valeur moyenne est inférieur à une certaine valeur limite, l'empreinte digitale est considérée comme vérifiée.

7. Agencement (100) destiné à être utilisé pour l'enregistrement d'informations d'empreintes digitales, comprenant une unité centrale (110), un capteur (120) ayant une surface de détection A, un doigt pouvant être retenu contre ou au-dessus d'au moins une partie de cette surface de détection A, et une unité d'alimentation en énergie (130), **caractérisé en ce qu'**il comprend :

- des moyens (110, 130) pour scanner des surfaces partielles A'_1 dans la surface de détection A du capteur (120),
- des moyens (110,130) pour analyser si le point central P_1, avec sa surface $A"_1$, qui l'entoure directement, d'une surface partielle scannée A'_1 est unique dans la surface partielle A'_1,
- des moyens (110,130) pour enregistrer un premier nombre de points centraux P_1 qui, avec leurs zones respectives $A"_1$ qui les entourent directement, sont uniques dans leurs surfaces partielles respectives A'_1,
- des moyens (110,130) pour l'enregistrement des surfaces partielles A'_2, dont les points centraux P_1 sont enregistrés.

8. Agencement (100) selon la revendication 6, comprenant également des moyens (110) pour sélectionner un certain second nombre des surfaces partielles enregistrées A'_1 avec des points centraux associés P_1 et des surfaces $A"_1$, qui les entourent directement, pour une utilisation ultérieure.

9. Agencement (100) destiné à être utilisé pour vérifier des empreintes digitales sur la base d'informations enregistrées précédemment et concernant au moins une empreinte digitale qui doit être approuvée au moyen de cet agencement, lesquelles informations comprennent des points centraux, les zones respectives, qui les entourent directement, et

leurs surfaces partielles respectives, l'agencement (100) comprenant une unité centrale (110), un capteur (120) comportant une surface de détection A, un doigt pouvant être retenu contre ou au-dessus d'au moins une partie de cette surface de détection A, et une unité d'alimentation en énergie (130), **caractérisé en ce qu'**il comprend ce qui suit :

- des moyens (110,130) pour comparer un nombre de surfaces partielles (A'_1) possédant des points centraux respectifs P_1 dans l'empreinte digitale, dont les informations sont enregistrées, à des surfaces partielles correspondantes A'_2 sur la surface de détection A,
- des moyens (110) pour sélectionner et approuver un certain nombre de points P_2, à raison de pas plus d'un point par surface partielle A'_2, avec des surfaces partielles correspondantes A'_2 sur la surface de détection A, lesquels points P_2, avec les surfaces A''_2, qui les entourent directement, correspondent, sur la base de certains critères, au point central mémorisé P_1, y compris la surface A''_1 qui les entoure directement, du point central mémorisé dans la surface de parties mémorisées correspondantes A'_1,
- des moyens (110) pour traiter les points approuvés lors d'une première étape lors d'un traitement suivant.

10. Agencement selon la revendication 9, comprenant également des moyens (110,130) pour déplacer des informations concernant les surfaces partielles A'_2, à des fins de comparaison avec les surfaces partielles A'_1, dans un nombre prédéterminé de positions angulaires, les moyens de comparaison (110,130) exécutant une comparaison dans chacune desdites positions angulaires, et les moyens (110) pour sélectionner et approuver un nombre de points, pour la première étape du traitement suivant, en approuvant ledit nombre de points P_2 de surfaces partielles A'_2, si ces points satisfont auxdites conditions dans une même position angulaire.

11. Agencement (100) selon la revendication 9 ou 10, comprenant également les moyens suivants pour exécuter ladite première étape lors du traitement suivant :

- des moyens (110) pour analyser un groupe de points approuvés P_2 et les surfaces partielles A_2,
- des moyens (110) pour calculer un point de valeur moyenne pour les coordonnées (x,y) des points P_2 dans les surfaces partielles A_2 du groupe,
- des moyens (110) pour sélectionner un certain nombre des points P_2 avec leurs surfaces partielles associées A_2 pour une seconde étape lors du traitement suivant, les points P_2, qui sont sélectionnés, étant les points qui possèdent la distance la plus faible par rapport au point de valeur moyenne dans leur surface partielle respective A_2.

12. Agencement (100) selon la revendication 11, comprenant également les moyens suivants pour exécuter ladite seconde étape lors du traitement suivant :

- des moyens (110) pour réaliser un groupe des points P_2 et les surfaces partielles A_2 sélectionnées pour une seconde étape,
- des moyens (110) pour calculer un point de valeur moyenne pour les coordonnées (x,y) des points P_2 dans les surfaces partielles A_2 du groupe,
- des moyens (110) pour calculer les distances entre les points P_2 dans le groupe et le point de valeur moyenne,
- des moyens (110) pour analyser si la distance entre un certain nombre de points P_2 et le point de valeur moyenne est inférieure à une certaine valeur limite, auquel cas l'empreinte digitale est considérée comme vérifiée.

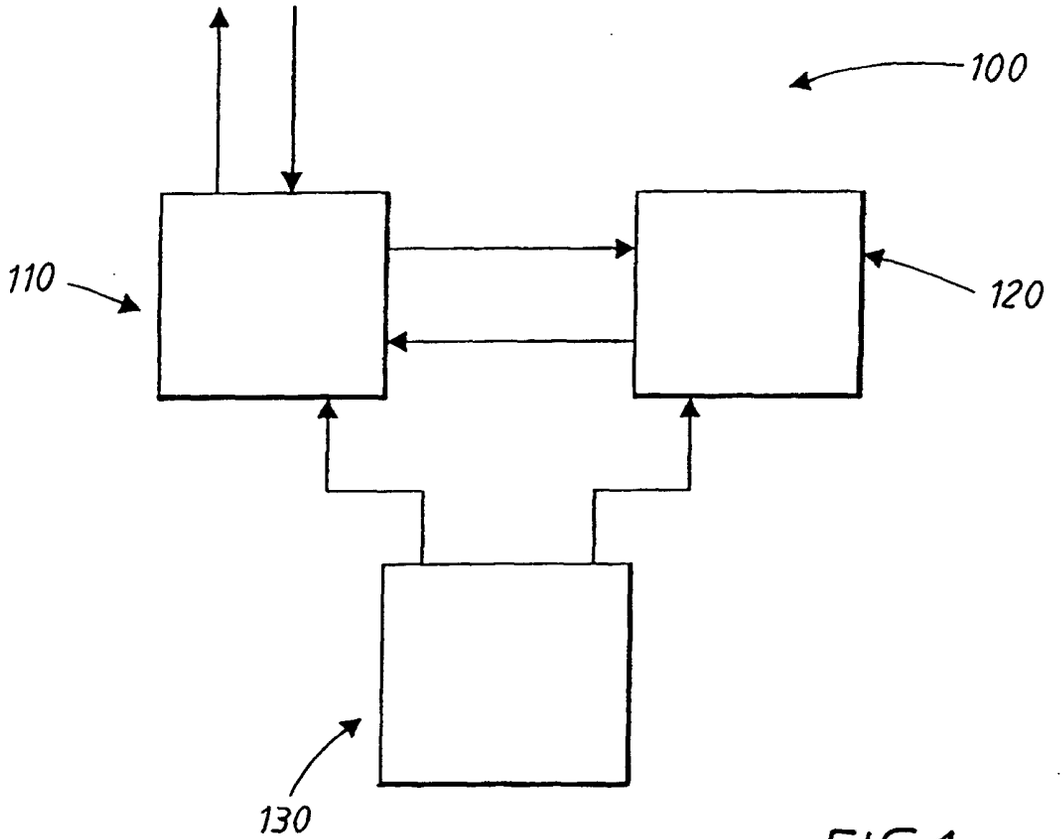

FIG. 1

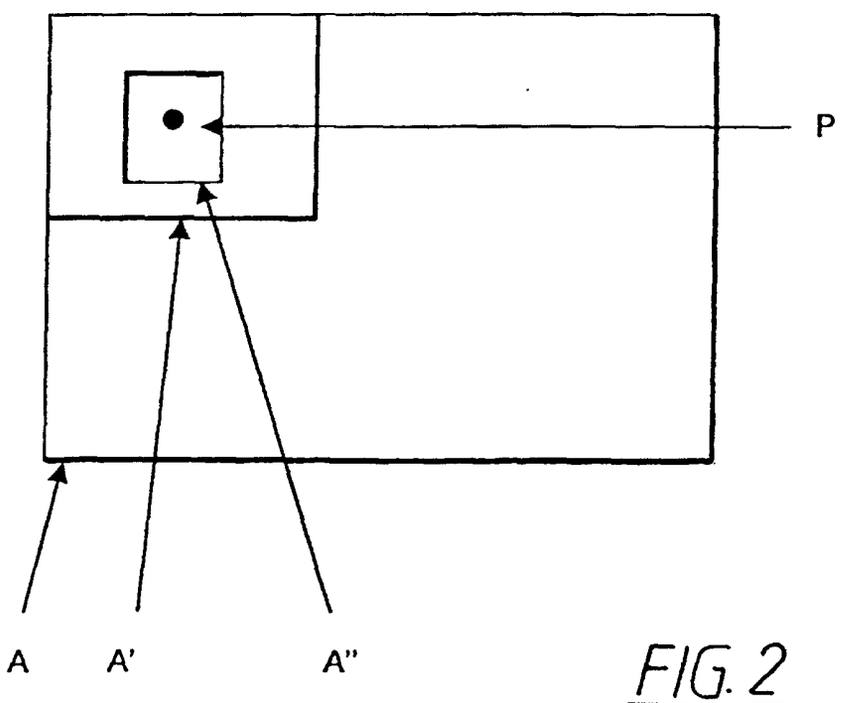

FIG. 2

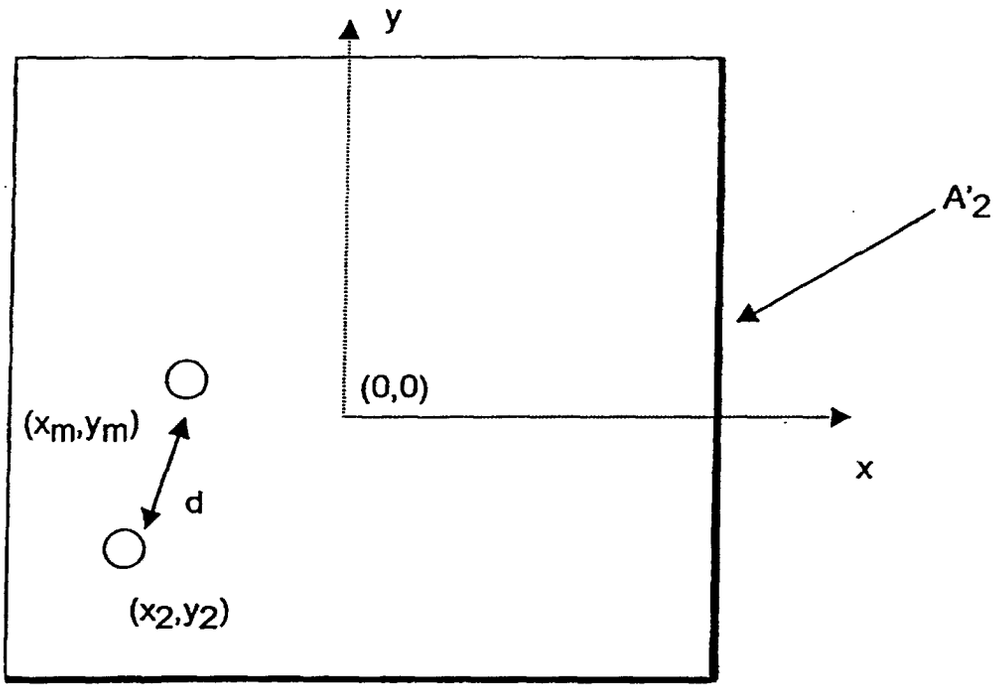

FIG. 3

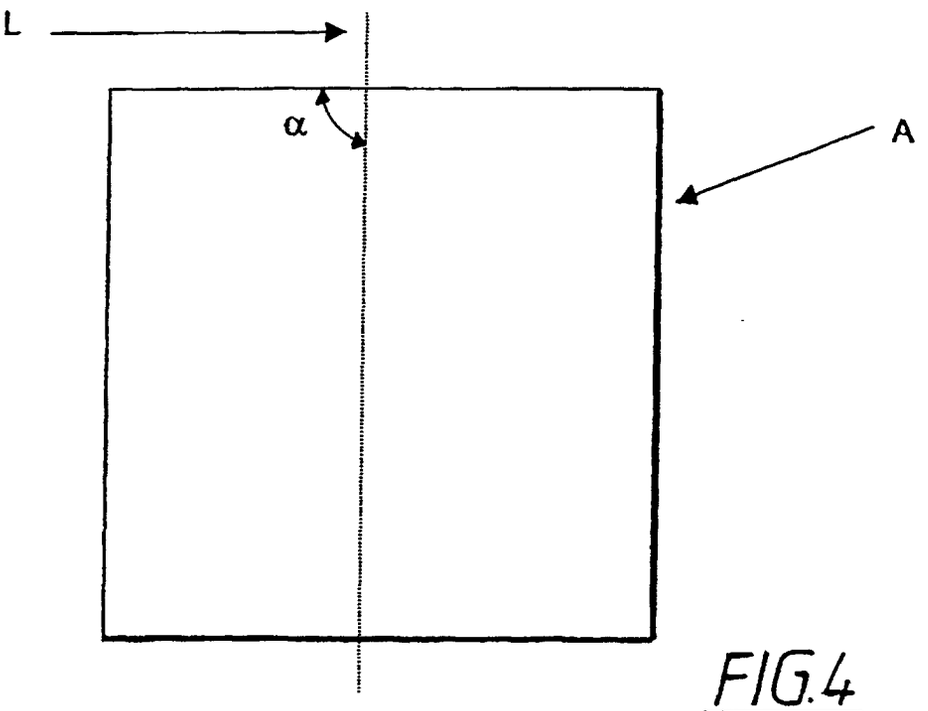

FIG.4